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UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

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NEW DELHI INDIA

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MEMORANDUM

TO PPC/CDIE/DA
Development Acquisition
USAID/Washington, D C

FROM John May
Acting Office Director, PDEG
USAID/New Delhi/India

SUBJECT **Project Assistance Completion Report (PACR)**

Attached please find the Project Assistance Completion Report (PACR) of USAID/India's bilateral project "Program Acceleration of Commercial Energy Research (PACER), 386-0494 for inclusion in the Development Information System

Att a/s

PROJECT ACTIVITY COMPLETION REPORT (PACR)

Program for the Acceleration of Commercial Energy Research (PACER)

1 Summary

The \$ 20 million PACER project (1987-97) helped overcome the energy constraints on India's economic development by promoting the development of new or innovative products or processes relevant to the Indian energy sector. Managed by Industrial Credit and Investment Corporation of India (ICICI), the project's priority areas included i) technologies to tap renewable energy, ii) coal conversion technologies, and iii) technologies to improve energy efficiency. Conditional grants of up to 75 percent of the project cost, subject to a maximum of \$ 3 million, were made available to consortia of manufacturers, research institutions, and/or end-users for technology development in the Indian energy sector. Repayments to PACER upon commercialization of the technology are based on a negotiated percentage of revenues not to exceed 200 percent of the original grant. Grants covering up to 80 percent of the research cost, subject to a maximum of \$ 400,000, were also awarded to research institutions for research in PACER priority areas. PACER also provided grant assistance, on a case by case basis, for policy analysis and studies related to energy sector.

PACER provided conditional grant assistance totaling \$ 15.6 million to 29 projects. These projects comprised of two solicited and twenty seven unsolicited proposals. Out of these, 18 projects have been completed, 5 are under implementation and the remaining 6 were truncated. The list providing names of promoters, project titles, total project cost, PACER contribution and project status is attached (Annex A). Out of the 18 completed projects, six have already been commercialized and repayments to PACER have started. The information regarding completion status of projects under implementation and commercialization plans of certain completed projects is given in Annex F.

PACER has had a positive impact on the energy research scenario in India. Several technology development projects relating to energy efficiency, energy conservation and alternative fuels were taken up. These might not have seen the light of the day but for PACER. Only a few projects like Bharat Heavy Electricals Limited (BHEL) "Pressurized fluidized bed gasifier" project might have materialized on their own, even without PACER. According to a report prepared by the Business Consulting Group (BCG) on "Review of PACER Program" the potential impact of PACER funded projects likely to see commercialization in India is very significant. It is estimated to be Rs. 73 billion, on an annualized basis, for the 12 projects visited by BCG. This speaks volumes for the national benefit of the PACER program.

Lessons Learned

A Project Approach

- The benefits of consortia research approach have been demonstrated by PACER. The program is replicable and could also be used in other sectors such as agro-processing, steel, electronics, waste management, telecommunications and watershed management. These are sectors where a pool of scientific personnel needs to work with the industry for the greater benefit of industry and country.
- A program like PACER needs external inputs from experts who can provide critical and unbiased insights into evaluation of projects. A strong and effective Peer Review Committee (PRC) helps considerably in selecting good projects.
- Adequate thought needs to be given to consortium fit and members' interest in commercialization. Consortium members should be selected carefully.
- Request for Proposal (RFP) approach should be preferred over unsolicited proposals. RFP should be initiated at the outset of such a program in order to channelize efforts in the desired direction at an early date.

B Implementation Approach

- A longer time frame is required to implement a program of this nature. Ten years' time frame is inadequate to see the fruits of such a program.
- Monitoring of assisted technology development projects can be improved by having clearly defined milestones/benchmarks. This would help in putting pressure on promoters towards sense of timing and results.
- The upper limit (\$ 3 million) of financing sub-projects under such programs needs to be flexible so that projects are not left incomplete due to lack of funds.
- The promoters' share of funding the project should be at least 30%. This is necessary to demonstrate promoters' commitment to the project.

C Sustainability

Indian industry is generally reluctant to deploy its high cost funds on Research and Development (R&D). PACER has financed many forward looking projects in the energy sector which would have otherwise not seen the day light. Programs like PACER lower the "risk" to industry and create a better environment for technology development and commercialization. The sustainability of energy research in non-

aid situations is doubtful in most cases given the pressing need to deploy the scarce high cost funds in competing areas. However, the technologies developed using PACER funds were relevant to Indian situation. Many of these hold good promise e.g. waste heat recovery based power generation in cement industry, beneficiation of high ash coal for power generation, distillery spent wash treatment alongwith cogeneration of power, solar thermal process steam generation. In order to adopt these technologies using their own funds, several Indian companies have begun approaching technology developers for technology transfer.

2 Project Background

A principal objective of USAID strategy in mid 1980s was to accentuate a trend toward a technological dynamic market. In pursuit of that objective, USAID designed and supported projects that (i) accelerated the pace and quality of technology development and innovation by strengthening the link between science and enterprise, (2) created an institutional environment in which technology innovation is fostered, and (3) stimulated public discussion on technology policy issues of national concern. The first project of this genre in USAID portfolio was the Program for Advancement of Commercial Technology (PACT). PACT was designed to promote INDO-U.S. joint ventures in technology development and thus to heighten the enterprise sector's interest in building research and technology development programs. PACER is the second project of this genre.

The goal of PACER is to accelerate the development and absorption of new and relevant energy technologies. The purpose was to develop, introduce, and test operational models for indigenous technology innovation and development in the Indian energy sector. The project has three inter-related components. Component One: Market-Driven Technology Development Consortia that provided financial support to consortia, comprised of a manufacturer in collaboration with a research institute and/or an end-user having a significant financial stake, organized to undertake specific technology development programs. Component Two: Competitive Awards Program for Supporting Research which supported a competitive research awards program in the topical areas defined by the Component one. Component Three: Supporting Analyses and Outreach was used to provide support for formulation of technology strategies, policy analyses, and information dissemination. In each of these components, proposals were solicited, reviewed, approved, and, if approved, financed.

Evolution of the project

The project approach, untried in the Indian context, was to catalyze the creation and implementation of goal-oriented, market-responsive consortia. These consortia were expected to bring together research and industrial institutions as well as end-users, from the Indian public and private sectors and in some cases with U.S. companies and institutions. The activities of the consortia were supported by a competitive research awards program as well as activities designed to analyze and disseminate

information of relevance to commercializing innovations PACER provided promotional assistance and finance in the form of conditional grants for meeting the project costs which absorbs some risks inherent in technology development Liability for payment towards the conditional grant arises when the technology is commercialized In addition, PACER provided grants for pursuing research in support of technology development projects

Program Thrust

PACER thrust was mainly on the development of innovative products and/or processes for identified priority areas of the Indian energy sector The illustrative list included

- i) Commercially attractive technologies to tap biomass or solar energy
 - o Biomass fired power unit
 - o Wind and photovoltaics
 - o Small-scale hydel
 - o Solar thermal electric power generation
- ii) Coal conversion technologies for low-grade Indian coals
 - o Fluidized bed combustion
 - o Slagging combustion
 - o Oil and water coal slurry techniques
 - o Coal beneficiation
- iii) Technologies to improve efficiency of major end-use electrical equipment in industry, agriculture and the commercial sector
 - o Variable speed drives
 - o Motors
 - o Lighting
 - o Efficient agricultural pump-sets
- iv) Technologies to make better use of available generating capacity
 - o Load levelling and load management control systems
 - o Energy storage
 - o Power plant instrumentation, monitoring and advanced diagnostics
 - o Cogeneration systems

Expected Accomplishment

The principal accomplishment of PACER will be the development of a successful model for technology innovation and commercialization in the Indian energy sector From this experience will come a deeper understanding of the dynamics of the innovation and commercialization in India and how best to facilitate the process Because the model of goal-oriented R&D consortia as an effective means for development and diffusion of commercially attractive advanced technology in the

Indian energy sector has not been tried as proposed in this project, there was no clear guarantee of the success. At the completion of the project, the following measurable results were expected

- i) Financed 4-6 market driven technology development consortia (Component One)
- ii) Completed 10-25 competitive research grants and a series of technical papers and reports discussing successful commercialization oriented research (Component Two)
- iii) Completed a series of authoritative studies on R&D strategies, technology commercialization and innovative policy approaches (Component Three)
- iv) Completed a series of information dissemination activities that would have stimulated public discussion and furthered the promotion of a technology development culture in India (Component Three)

Design Issues

USAID review of the Project Paper (PP) in the design stage identified a major substantive issue as to how funds would be transferred to consortium members under Component One. The original PP proposed that non-profit making consortia members receive grant finance from the Department of Non-Conventional Energy Sources (DNES) and the profit making members receive conditional grants from the Industrial Credit and Investment Corporation (ICICI). However, as a result of discussions at the USAID's Mission Review Committee (MRC) meeting, this was changed. The consortium members were required to identify a lead organization. This organization receives the entire amount of support authorized to the project in the form of a conditional grant from ICICI and in turn transfers the funds to other consortium participants through contractual arrangements.

Mid-Term Evaluation

A scheduled mid-term evaluation of PACER was conducted in April/May 1991. The purpose of this evaluation was to provide recommendations on the basis of a comprehensive look at the design, implementation and impact of the project. General questions addressed in this evaluation included suitability of the project design, success in implementation, progress and outlook for current projects, needs for adjustments and general recommendations for guiding the future course of the project. The evaluation was conducted by a four member team headed by Dr William Ramsay contracted by the International Resource Group (IRG), a Washington-based consulting firm. Evaluation methodology included review of PACER project documents and records at ICICI, PACER sub-grantees and USAID, interviews with the officials of DNES, ICICI/ PACER Secretariat, sub-grantees and USAID and members of ERDAC and PRC as well as independent scientists, engineers and businessmen, and selected site visits to sub-projects funded by PACER.

The evaluation team found that though the concept of PACER was innovative, valid and timely in the Indian context, it was difficult to convey the goal and project design to the Indian technological and industrial community. Accordingly, the project had a slow start. However, since the PACER Conference in April 1990, the project had shown considerable momentum and interest. The team made a series of recommendations to increase the effectiveness and probability of PACER success. The team also recommended Project Assistance Completion Date (PACD) extension for the project. The list of 23 recommendations made by the evaluation team and the comments made by PACER Secretariat against each is attached (Annex B). In the USAID's Mission Review Committee (MRC) meeting held on May 20, 1991, USAID approved the evaluation report and the recommendations contained therein except those related to priority setting (Recommendations #1), limiting the amount of PACER funding to \$ 2 million (Recommendation # 2), PACER funding to organizations that have other sources of funding (Recommendation # 4), grant repayment and long-term financial plans (Recommendations # 17 & 18). The recommendation # 14 pertaining to PACER not funding any policy studies was accepted with the modification that such studies can be funded in exceptional cases only. A copy of the Minutes of MRC May 20, 91 meeting is attached (Annex C). No action is pending on the evaluation recommendations that were accepted by the Mission.

3 Implementation Mechanism and Status

Administrative Structure

PACER was implemented by ICICI in collaboration with the Ministry of Non-Conventional Energy Sources (MNES) formerly known as DNES. An Energy Research and Development Advisory Committee (ERDAC), chaired by the Secretary, MNES provided overall guidance for the management of the project. In addition to the chairman, ERDAC had eight members who were drawn from industry, finance, business, and research community. ERDAC meetings were held on as needed basis and its functional responsibilities were executed by the Committee as a whole or by sub-groups of the Committee, as deemed appropriate. Accordingly, a Peer Review Committee (PRC) was formed to review and approve projects upto Rs 4 million. To handle day to day implementation chores of the project, a Secretariat (PACER Secretariat) was established in ICICI, Mumbai.

Proposals Review and Approval Process

PACER envisaged receiving proposals through formal solicitations. However, unsolicited proposals were also considered for assistance. Proposals on specific subjects were invited through Requests for Proposal (RFP) process which was prepared by PACER Secretariat in consultation with ERDAC. The RFP mechanism involved inviting bids on competitive basis for assigning development projects to the most suitable and competent proposers. Proposals received in response to RFP were processed by PACER Secretariat and were placed before PRC/ERDAC for

approval

Unsolicited proposals were also accepted under components one, two and three in instances when a proposal was judged to be of a particular merit. Evaluation of proposals for assistance under PACER was conducted by PACER Secretariat and PRC/ERDAC, as appropriate, with the assistance of industry experts/ consultants. An illustrative list of criteria for evaluating proposals is given below:

- i) Nature and degree of innovative content in relation to state-of-the-art
- ii) Potential for commercialization of technology
- iii) Relevance and significance of technology in achieving PACER objectives
- iv) Track record of the participants in terms of technology base and skills, manufacturing and marketing capability as well as availability of financial resources
- v) A satisfactory return on capital employed as indicated by the business plan

Both solicited and unsolicited proposals received under the three components underwent a rigorous technical peer review as well as a business plan/financial review. The process began with an initial technical screening of proposals by ERDAC members to determine those which show greatest potential for successful commercialization and promise to have the greatest impact on the Indian energy supply. Proposals accepted by ERDAC underwent a more intensive review by a panel selected by PRC before the review by ERDAC for approval. PACER contribution to a particular project was limited to 75% (previously 50%) of the total cost of the project, subject to a maximum of \$ 3 million.

Roles of ICICI, MNES and USAID

PACER Grant Agreement was signed between ICICI and USAID. ICICI was the implementing agency for PACER and the home of PACER Secretariat which managed the day to day operations of the project. The MNES role was to coordinate the project and guide and oversee its implementation. While the responsibility of soliciting and receiving unsolicited proposals and processing the same for approval vested with ICICI, the approval of sub-projects under PACER was the responsibility of ERDAC constituted by MNES with the Secretary MNES as its ex-officio Chairman. The responsibility of disbursing grant funds and monitoring the activities rested with ICICI. A three-tier administrative system, with ERDAC as the apex body was created. The other two tiers were the Peer Review Committee (PRC) constituted by ERDAC to serve as its technical arm and PACER Secretariat working staff in ICICI. PRC served as a link between the PACER Secretariat and ERDAC. PRC was delegated powers to approve sub-projects costing up to Rs 4 million. Subsequently, ERDAC authorized PRC to approve all projects (without any upper funding limit) and the lists of projects approved by PRC to be placed at next ERDAC meeting for ratification. PRC was chaired by the Advisor, MNES who was also member-Secretary of ERDAC. The members of PRC were drawn from ICICI, National Productivity Council, Indian Institute of Technology (IIT)/ Mumbai, National Council of Power Utilities and Indian Renewable Energy Development Agency (IREDA). All the PRC members were also members of ERDAC. PACER Secretariat in ICICI was the administrative unit responsible for execution of the project. It

worked in close cooperation with MNES. USAID was responsible to work with MNES and ICICI to monitor the progress of the project. USAID also functioned as a bridge between the Indian and U.S. energy scientists and technologists. In USAID, the responsibility for managing PACER rested with the Office of Environment, Energy and Enterprise (E³). A senior FSN professional was responsible to manage the project in E³. In addition, technical assistance from U.S. Department of Energy (USDOE) Federal Energy Technology Centre (FETC) was used to provide support to ICICI for implementing certain activities under the project.

Status under Market Driven Technology Development Consortia

PACER Secretariat received over 350 unsolicited proposals. Of these, project profiles were prepared for about 80 proposals and presented to PRC and ERDAC for review. ERDAC/PRC rejected 40 profiles and asked PACER Secretariat to get full proposals from the remaining 40 proposers. Of these 40 proposals, twenty-nine subprojects involving PACER contribution of \$ 15.6 million were approved and financed under PACER. Of these, 18 have been successfully completed, 5 are under implementation and the remaining 6 were truncated due to various reasons. The details of these projects are provided in Annex A. These projects can be classified into four categories viz. energy efficiency (13), renewable energy (8), new fuels (5) and beneficiation of low grade fuel (3). The major share of PACER funding (49%) went to the five new fuel development projects while the remaining (51%) went to the other twenty-four projects in three categories -- beneficiation of low grade fuels (3 projects with 27%), energy efficiency, (13 projects with 17%), and renewable energy (8 projects with 7%). Of the 18 completed projects, six have already started commercialization and the remaining 12 are likely to start commercialization in a phased manner in the coming years. PACER has started receiving reflows from the projects that have started commercialization. PACER presently has reflows totaling Rs. 55 million. Reflows are being used by ICICI to continue funding new projects meeting PACER criteria.

Of the 29 PACER funded projects, 12 projects were reviewed and visited by the Business Consulting Group (BCG) in June/July 1997 under a study commissioned by ICICI to prepare a report on "Review of PACER Program". According to the BCG study these 12 projects are expected to save India Rs. 73 Billion (approximately \$1.9 Billion). The remaining 11 projects could add further to this figure. When compared to PACER funding of \$15.6 million during the last ten years across 29 projects, it is clear that the multiplier effect of PACER on the Indian economy is expected to be very high. Excerpt of BCG study report providing details of projects visited by them is attached (Annex D).

Status under Competitive Awards Program

Under this component, only one award of \$ 64,000 was made to Eco Solar Systems (India) Pvt. Ltd., Pune for the development of a prototype line for manufacturing 700 KW of 300 x 300 mm Cds/Cd Te solar cells using high-speed close-spaced

sublimation and deposition under vacuum in collaboration with the Colorado State University (CSU) and National Physical Laboratory (NPL) The technology has been successfully developed and demonstrated Plans are underway to commercialize the technology developed by Ecosolar

Status under Supporting Analysis, Outreach and Research Program

A total of approximately \$ 676,000 was disbursed under this component Out of this, \$218,000 was spent on PACER conference, \$56,000 on PACER outreach, and remaining \$402,000 on research projects In all, eight research projects involving PACER contribution of Rs 6 million were approved and funded under this component A summary description of these projects is given in Annex A Of these, four projects covered policy related studies, two were involved with technology oriented feasibility studies, and the remaining two were for conducting surveys Although the category 'research' appeared to correspond naturally to Component Two of PACER, in practice -- all of the research projects have been funded under Component Three, probably because these fit in very well with the Component Three goals

Status Under U S Short-term Technical Support

Under this component approximately \$ 472,000 was obligated in U S Department of Energy (DOE), Federal Energy Training Centre (FETC) Participatory Agency Services Agreement (PASA) to obtain FETC technical and project management expertise in the selection, screening, monitoring and evaluation of energy projects proposed to be funded under PACER FETC, a lead coal R&D center in the U S , has been providing technical and management support to USAID funded Indian coal research, development and demonstration projects since 1983 Some of the PACER assisted projects that received FETC technical assistance include i) BHEL's Integrated Gasification Combined Cycle Coal (IGCC) using pressurized fluidized bed gasification (PFBG) pilot plant at Trichy, ii) Spectrum Technology/Bombay Suburban Electric Supply (ST/BSES) demonstration- cum-commercial coal washery, iii) Oil India/HT1 coal-oil co-processing project, and iv) Essar India/Coal India Coal bed methane project In addition, DOE/FETC provided programmatic and logistic support for the U S visit of Indian consortium members and project promoters of PACER funded projects The coal projects assisted under this PASA and previous USAID funded projects [Alternative Energy Resource Development (AERD) and Energy Management Consultation and Training (EMCAT)] provided the basis for development of a larger USAID initiative, in the climate change area -- Greenhouse Gas Pollution Prevention (GEP)

4 Summary of Contributions made by Parties

USAID Contribution

PACER life of project (LOP) funding estimated as \$ 32.5 million was planned to be

provided by USAID (\$ 20 million), Project promoters (\$12 million) the Ministry of Non-Conventional Energy Sources (MNES) (\$0 3 million), and ICICI (\$0 2 million) However, USAID obligated only \$17 446 million in various elements of the project out of which \$ 17 350 was disbursed The element-wise details of USAID obligations and disbursements are as follows

Project Elements	(Thousand of dollars)	
	Obligations	Disbursements
Market Driven Technology Development Consortia	15,707	15,636
Competitive Awards Program	64	64
Supporting Analyses and Outreach	676	676
U S Short-term Assistance	472	472
Project Administration	450	450
Project Evaluation	77	52
	-----	-----
Total	17,446	17,350
	=====	=====

Host Country Contribution

PACER Host Country Contribution (HCC) totalled approximately Rs 515 million (\$ 40 9 million) (average exchange rate of Rs 12 6 equals \$ 1) as against the estimated HCC of \$ 12 5 million This includes in-kind contribution of Rs 37 6 million (approx \$ 3 million) made by project proposers and ICICI The element-wise details of HCC are shown in Annex E

5 Audits

Financial audits for ICICI-PACER Secretariat (including sub-recipients' audit) have been completed upto March 31, 1997 ICICI has taken necessary follow-up actions Audit report for FY 1996-97 has been sent to RIG for review and issuance The final audit for the period April 1, 1997 to August 31, 1997, the PACD of PACER, is in progress and expected to be completed by mid-July 1998 and audit report will be submitted to USAID by July 31, 1998 Fund Accountability Statements (FAS) for all sub-recipients have been received by ICICI and scrutinised by ICICI auditors Audit finding with respect to one sub-recipient is being followed by ICICI

6 Post Project Monitoring Actions

a) Reflows

Pursuant to ICICI and GOI request of November 28, 1994, USAID agreed vide its letter of January 30, 1995 to the pooling of reflows from USAID's PACT, PACER, ACE and TEST projects under a common reflow account These reflows will be used by ICICI to fund new projects meeting the project objectives and criteria of

USAID's technology development and commercialization program comprising of PACT, PACER, ACE and TEST projects ICICI, will however, submit a quarterly status report showing details of reflows due and received under each project and amount utilized for funding new projects during the reporting period as well as cumulative information as at the end of the quarter

b) Audits

ICICI will carry out pending close-out audits, if any, and take appropriate actions to resolve and close findings identified by these audits, if any, by December 31, 1998

7 Accomplishments Under Various Project Elements

PACER concepts and objectives were valid and timely for India PACER was seen as playing the role of a catalyst in India's energy sector as it has tried out innovative strategies to develop technologies and bringing them to the commercialization stage The consortium approach has helped to bridge the large gap between the knowledge and expertise available in research institutions & universities and their utilization by the industry PACER has demonstrated the benefits of the consortia research approach Another highly rated contribution of PACER has been its emphasis on bringing the users and manufacturers together in joint programs

The concept of conditional grant, which was first introduced in India in the PACT program, received much publicity as a result of PACER PACER has financed many 'forward looking' projects in the energy sector which would have otherwise not seen the light of the day PACER financing lowered the risk to industry and thus created a better environment for technology development in the energy sector

PACER's components Two and Three were instrumental in fostering bonds between the research community and industry The research projects funded under these components were directly linked with consortia projects In all 29 consortia projects (Component One), 1 grant under competitive awards program (Component Two) and 8 research projects (Component Three) involving PACER assistance of \$ 16.4 million were funded Some of the projects financed have already started showing returns while some big projects like Spectrum Technologies/Bombay Suburban Electric Supply (ST/BSES), Caldyn/Shree Cement, Bharat Heavy Electricals Ltd (BHEL) and Essar Oil will benefit the country in coming years

To sum-up, PACER has functioned extremely well under a very difficult set of boundary conditions The support provided by ICICI management, ERDAC and PRC has been exemplary Despite limitations, PACER has created awareness of the possibilities of commercializing technology using research process MNES has played a key role in the implementation of PACER It has provided intensive guidance to ICICI/PACER Secretariat in implementing the project Significant PACER accomplishments include

- First commercial scale coal washery in the private sector involving the consortium of project developers - Spectrum Technologies & technology providers (CLI Corporation), BSES (end user) and DOE, (Coal R&D institution)
- First pilot scale Pressurized Fluidized Bed Gasification (PFBG) based Integrated Combined Cycle Coal Gasification (IGCC) plant at BHEL, Trichy
- The largest Fuels Evaluation Test Facility in South Asia
- Technology transfer and proof of concept demonstration on pilot scale in Coal-Oil coprocessing and Coal-Bed Methane in India
- Institutional linkages between US DOE national laboratories and coal R&D facilities and Indian Governmental and private energy sector and coal R&D organizations

Sustainability

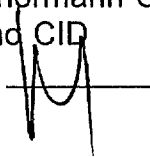
For Indian industry, the risks associated with failure of research in the energy sector are very high primarily because of the high cost of commercial funds. In such a scenario, sustainability of energy research in non-aid based situations is doubtful in most cases. The only exception could be few large organizations that might take up such projects on their own provided the project lies within their area of operation and they foresee a significant commercialization benefit. Therefore, till the R&D culture becomes an inherent part of Indian industry, externally aided catalyst such as PACER are important to foster technology development. The concept of "Consortium" introduced by PACER brings together an idea (technology developer), an implementer (for commercializing the technology) and an institutional financier. PACER has demonstrated the benefits of consortia research approach. The carrying forward of this approach in India will be a function of two important factors viz i) consortium fit - the members of the consortium need to have faith and trust in each other to enable completion of project on schedule, and ii) interest in commercialization - all the members need to have a commercial interest in completion of the project.

8 Lessons Learned for the Future

- The start-up of PACER type program involves considerable time. Ten years' time frame is inadequate to see the results of such a program. Thus time frame for such program needs to be longer, around 15 years.
- The selection of project consortium members should be carefully evaluated to weed out those who don't have interest in commercialization of the technology or those who have inadequate fit compared to the project size.

- The criteria and mechanism used for selection and approval of projects is good and needs to be continued. However, the RFP approach should be preferred over unsolicited proposals and more emphasis should be placed on initiating the RFP process early in the project to solicit quality proposals
- The extent of PACER funding which was originally up to 50% and later increased to 75% of the total cost appears reasonable. However, the upper percentage limit should be used selectively keeping in view the size of the project and extent of promoters' financial commitment
- Monitoring of assisted projects can be improved by having clearly defined milestones/benchmarks. This would help in monitoring and putting pressure on project promoters towards sense of timing and results
- A program like PACER needs external inputs from experts who can provide critical and unbiased insight for the evaluation of project proposals. Thus a strong and effective Peer Review Committee (PRC) will help in selecting good projects. However, the implementing agency needs to be given more powers in the approval process
- Benefits of consortia research have been demonstrated by PACER. PACER program is replicable and could be used in other sectors such as agro-processing, biotechnology, electronics etc to great benefit. These are sectors where a pool of scientific personnel needs to work with industry for the benefit of the country

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Annex A

Consolidated List of Projects/Activities funded under PACER

S No	Subproject Participants/Project Title	Est Total Cost of Project	PACER Assistance		Project Status	
		(Rupees)	Sanctioned (\$)	Disbursed (Rupees)	(\$)	
		(Figures in thousands)				
1	COMPONENT I - Market Driven Technology Development Consortia Thermax Limited (lead) Trinity Forge (P) Ltd -development & demonstration of regenerative burner system	1600	-	750	45	C
2	Nagadi Consultants (lead) Micro Controls TI Cycles of India - development and demonstration of low cost combustion control system based on oxygen sensing	800	-	378	23	C
3	SPIC Science Foundation (lead) SPIC Limited - development & demonstration of Solid Polymer Electrostyle Fuel Cell Stacks range 1-5 KW	25525	29	11400	543	C
4	Ankur Energy & Development Alternative (lead) Ankur Scientific Energy Technologies Pvt Ltd - development of 500 KW biomass gassifier based power generation systems	2000	-	1000	48	C
5	Fluidtherm Technology Pvt Ltd (lead) Indian Institute of Technology, Chennai TI Diamond Chain Ltd - development of continuous fluidised bed	8200		3460	161	C

S No	Subproject Participants/Project Title	Est Total	PACER Assistance		Project
		Cost of Project	Sanctioned	Disbursed	Status
		(Rupees)	(\$)	(Rupees)	(\$)
	furnaces for heat treatment				
6	Metallurgical & Engineering Consultants (lead) Bokaro Steel Plant - development of desiccant cooling system using industrial waste heat	1100	220	8	T
7	HBL Limited/PLUMAC (lead) Hyderabad Batteries Limited -dev of deep cycling lead acid batteries	5300	2000	66	C
8	Bharat Heavy Electricals Limited (lead) Indian Institute of Technology Chennai - dev & demonstration of 150 TPD pressurised fluidised bed coal gasification with combined cycle technology for power plant	130992	85	63000	2129
9	Ankur Energy & Development Alternative (lead) Ankur Scientific Energy Technologies Pvt Ltd market dev of 500 KW biomass gassifiers	1050	-	650	25
10	Essar Oil Limited (lead) Gujarat Industrial & Investment Corp Ltd (GIIC) Coal India Limited - pilot project for exploiting coal bed methane	104484	888	22900	1607
11	S&S Power Switchgear Limited (lead) Indian Institute of Technology Chennai - development of Vacuum Auto Recloser with magnetic actuator for tail-end distribution system	5200	-	2600	83
12	Vasantdada Sugar Institute (lead) Krishna SSK Limited	70000	-	30000	930

S No	Subproject Participants/Project Title	Est Total Cost of Project (Rupees)		PACER Assistance Sanctioned (\$)	Disbursed (\$)	Project Status
13	Filtron Engineers Pvt Ltd demonstration of technology for treatment of distillery spentwash along with cogeneration Save Oil Technology (lead) Synergy Emulsifier P Ltd National Chemical Laboratory Sunderson Machines Pvt Ltd -dev of emulsifier & suitable blending machine	2300	-	600	19	T
14	Solker Enterprises P Ltd (lead) Anna University - market seeding for acclerating commercialisation of an innovative Solar Meal Maker	6200	-	2700	79	T
15	SECO Controls Pvt Ltd -market development programme for combustion control system	1700	-	1200	38	C
16	Electrodynamics Industries Ltd (lead) Indian Institute of Technology, Chennai - energy efficient high frequency portable tools	9000	-	6750	200	C
17	Grain Processing Industries Pvt Ltd (lead) Bijoy Lakshmi Rice Miff Indian institute of Technology, Kharagpur -upgradation of tech for 500 KVA power gen system based on gassification of rice husk	4200	-	2100	66	C
18	Linnhoff March Inc (lead) Kinetics Technology (1) Ltd - dev of advanced process integration technology	65161	828	13400	1248	C

S No	Subproject Participants/Project Title	Est Total	PACER Assistance		Project
		Cost of Project	Sanctioned	Disbursed	Status
		(Rupees)	(\$)	(Rupees)	(\$)
	for energy conservation and waste reduction				
19	EcoSolar Systems (1) Pvt Ltd (lead) Colarado State University, USA National Physical Laboratory - dev & demonstration of prototype line for the manufacture of CdS/CdTe solar cells	31644	101	20100	649 C
20	Suryodaya Hi-tech Engg Pvt Ltd (lead) National Aerospace Laboratories ITC Bhadrachalam Paper Boards Ltd - dev & demonstration of technology of solar thermal process steam generation plant	18000	-	9000	258 UI
21	A J Electronics (lead) Machinocraft Pvt Limited (lead) School of Energy Pune University Surya Technical Consultancy P Ltd Shivamrut Doodh Utpadak Sangh Limited - dev & demonstration of technology of solar thermal process steam generation plant	3340	-	2500	72 C
22	Dhar Cement Limited (lead) Caldyn Inc , USA Caldyn Consultants Pvt Ltd - pilot commercialization of power generation system for cement ind using waste heat and agrowaste	18923	-	5000	553 T
23	UNDSEM Foundation (lead) Ahmedabd Textile Industry Research Association -development of lignite water fuel technology	272100	-	670	20 T

S No	Subproject Participants/Project Title	Est Total	PACER Assistance		Project	
		Cost of Project	Sanctioned	Disbursed	Status	
		(Rupees)	(\$)	(Rupees)	(\$)	
24	Elpro International Limited (lead) Sunpower Inc , USA - development of biomass fired free piston stirling engine based water pump	12000	-	8500	242	UI
25	Oil India Limited (lead) HRI Inc USA - pilot plant for co-processing of Assam coal & oil into clean liquid fuels	125375	1175	9470	1440	UI
26	ST-BSES Coal Washeries Limited (lead) CLI Corporation USA -advanced plant for beneficiation of high ash coal	130505	2243	18800	2763	UI
27	CaldynThermowir Pvt Ltd (lead) Caldyn Inc USA Shree Cement Ltd -pilot demonstration & market dev of waste heat recovery based power plant in cement industry	70485	135	48400	1490	C
28	CLI Coal handling co Pvt Ltd (lead) CLI Inc , USA ST BSES Coal Washeries Limited - upgraclation of demonstration project for deeper beneficiation of high ash content Indian coal	37750	600	6900	800	UI
29	Lotus Energy Systems Pvt Ltd (lead) National Aeronautical Laboratory - Development of co-generation plant (1000 KVA 600 kg/hour steam) based on phased out aero- engines with automated control system	1400	-	610	31	T
	SUB-TOTAL COMPONENT I	1166334	6084	295058	15636	

S No	Subproject Participants/Project Title	Est Total	PACER Assistance		Project
		Cost of Project	Sanctioned	Disbursed	Status
		(Rupees)	(\$)	(Rupees)	(\$)
	COMPONENT II Competitive Awards Programme				
1	Eco solar Systems (India) Pvt Ltd Colorado State University, USA National Physical Laboratory - Development of prototype line for the manufacture of Cds/CdTe solar cells		64	-	64
	SUB-TOTAL COMPONENT II	0	64	0	64
	COMPONENT III (Supporting Analysis & Outreach)				
	Research Projects				
1	Tata Energy Research Institute, New Delhi - Policy directions for smoothening the load duration curve in India	1999		1999	117
2	Tata Energy Research Institute, New Delhi - Assessing efficiencies of appliance in the domestic sector	1825		1825	106
3	Tata Energy Research Institute New Delhi - Working out strategies for indigenisation of grids connected wind electric generators	231		231	14
4	Nimbhkar Agricultural Research Institute, Phaltan - Techno economic feasibility project for setting up 10 MW e biomass based electric power stations in Maharashtra	290		290	16
5	I J Raju and Associates New Delhi - Optimal utilisation of natural gas in India	216		216	13 C
6	Indira Gandhi Institute of Development Research	320		320	17 C

S No	Subproject Participants/Project Title	Est Total	PACER Assistance		Project
		Cost of Project	Sanctioned	Disbursed	Status
		(Rupees)	(\$)	(Rupees)	(\$)
7	- Evolving policy on use of natural gas in transport sector Dr Rao Associates, Hyderabad	450	450	23	C
8	- Research project on technology development in medium temperature range (120-160 deg C) solar thermal process heat industrial applications Andhra University, Vishakapatnam	645	645	30	C
	- Estimation of export demand potential for renewable sources in energy in the developing countries				
	Grand Total	1172310	6148	301034	16036

C = Completed

UI = Under Implementation

T = Truncated

PROGRAM FOR ACCELERATION OF COMMERCIAL ENERGY RESEARCH

Annex B

(PACER)

MID TERM EVALUATION :

RECOMMENDATIONS AND

PACER SECRETARIAT'S COMMENTS ON RECOMMENDATIONS

No.	RECOMMENDATIONS	COMMENTS	REMARKS
1	A well-rounded and flexible approach to the various fields of energy technology should be maintained, and no strict priorities should be established, as long as they are consistent with the general priority philosophies of the National Energy Plan.	We agree with the recommendation	So far similar approach has been followed.
	The maximum amount of PACER contribution to any project be limited to \$ 2.0 million.	There is no need to change from the existing limit of \$ 3 m to a lower figure. Our up-to-date experience suggests that rarely do we get project seeking assistance amount exceeding \$ 2 m. Therefore in the rare event of any impact making significant project envisaging an assistance amount above \$ 2 m can still be accommodated within the present limit e.g. clean coal technology project of BHEL.	While conceptualising PACER project, upper limit of US \$ 3 million to a single project was decided to take case of large R&D projects particularly relating to coal/oil technologies
2	No single organization be the prime consortium or research project leader on more than two projects.	We agree with the recommendation.	Normally this is observed. Only in the initial stage of PACER, three research study projects of TERI were assisted. When any proposer comes up with a list of R&D

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P.NO.	RECOMMENDATIONS	COMMENTS	REMARKS
			proposals, only one of them is picked up, after prioritising.
4.	No organization that is capable of generating funds from their internal sources or has ready access to funds other than PACER be given PACER financing. This evaluation should be conducted at the pre-appraisal stage itself, so that companies that are not eligible do not have to go through the proposal and appraisal stages.	Significant R&D projects are normally undertaken by financially sound and resourceful companies. If PACER has to support important consortium R&D project, it is not desirable to follow this suggestion. Therefore, we do not agree.	e.g. proposals from BHEL, Oil India Limited, Thermax, Tata Chemicals Ltd., TISCO, etc. need to be considered on the basis of technology proposed to be developed
5.	The RFP topics should be carefully vetted by the PRC/ERDAC and some expert individual/organization selected for this purpose, before they are published as RFPs.	We agree with the recommendation	After necessary deliberations at the PRC/ERDAC and consulting some experts, suitable action plan has been drawn up and is under implementation. e.g. Dr. Rao Associates working on solar thermal project.
6.	Project appraisals should include competent evaluations of technical, economic and financial aspects of the projects. The economic analysis should include methodologies which take into account all relevant factors related to conventional and renewable energy technologies, including life-cycle costing, hidden costs and short-and long-term environmental impacts. A formal list	While it would be desirable to follow these recommendations, the practicality of the same is doubtful in the Indian context without sacrificing the prime object of PACER. Such processes might contribute to delays. However life cycle costing can be incorporated. The aspect of hidden cost	A roster of experts is being prepared. It is proposed to associate experts at review stage on selective basis.

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SR.NO.	RECOMMENDATIONS	COMMENTS	REMARKS
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of organizations and individuals be created with experience in the technology and economic areas. One or more of the most relevant organization or individual, chosen for their particular expertise, would be called upon to review each proposal appraisal and brief the PRC/ERDAC. They should not be members of ERDAC/PRC and their time should be compensated.

might be suitably dealt with but might invite controversies.

7. The project appraisal should include a separate section on "Environmental considerations". Because of the importance of environmental analysis in energy projects, this should be an important consideration for all PACER-Funded projects.

We agree with the recommendation

Impact on environment is now being included as one of the important aspects in the appraisal.

8. PACER should fund at a modest level a research project to establish a methodology which should be followed in all PACER evaluation.

This can be explored.

9. PACER should commission survey studies to generate classes of new ideas for subprojects.

We may commission survey studies.

10. The composition of ERDAC should be extended to also reflect energy sectors like oil and gas and institutions like CSIR and the Planning Commission.

DNES may consider including representatives of oil, gas and CSIR. Association of Planning Commission may not be warranted in view of size of PACER funds.

Informally PACER interacts with relevant organisations in selective manner.

11. PACER should at periodic intervals, arrange seminars/workshops, not only to familiarize the industry with the PACER concept, but also to promote the generation of new ideas which may lead to consortium projects.

We have been arranging such workshops/seminars.

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SR.NO.	RECOMMENDATIONS	COMMENTS	REMARKS
12.	The PACER Secretariat should pull in some expertise from its parent organization to assist in the commercialization stage of the consortium projects, on an as-needed basis.	We draw on in-house resources of ICICI from time to time.	
13.	Components two and three should be merged. All research projects be directly linked with consortia projects, either on topics that are being dealt with by consortia or will lead to consortia projects.	Agreed	Now rarely do we encourage a policy 'y'.
14.	PACER should not fund any policy studies. Only consortium projects and research projects that are directly related to consortium projects should be funded.	If there is a felt need we should support policy studies.	
15.	The consortium concept should be continued under the PACER program. Continued attention should be paid to the manufacturer/end-user collaboration.	As far as possible this goal is pursued. We also try to associate R&D institution/University/IIT.	
16.	The maximum amount of PACER financing should not be increased to more than the present 65%.	We agree with the recommendation	65% indicates maximum assistance. Actual amount is decided on the basis of needs and resources of client.
17.	Conditional Grants should take into account the payback period.	We agree with the recommendation	PACER Secretariat proposes considering the linkage with repayment period in deserving cases.

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SR.NO.	RECOMMENDATIONS	COMMENTS	REMARKS
18.	PACER Secretariat should draw up a "Financial Plan" to be submitted to PRC and ERDAC no later than December 31, 1991. This financial plan should indicate the likely payback amounts and the anticipated periods, and when it is likely that PACER will be self-supporting. An organizational and implementation plan of PACER beyond the USAID assistance stage should also be included, identifying possible sources of additional venture capital funds.	In view of the present stage of implementation of PACER and its sub-projects as also their long lead times, extension of PACD to 1996, it would be too early to undertake such an exercise. However, it could be taken up in 2nd half of 1992. It may be noted that according to USAID, PACER is not designed to create a revolving fund for supporting projects beyond PACD date, but to establish and sustain the concept of consortium research in India.	
19.	The PACER program should be extended beyond its present completion date of June 30, 1993 by 3 years to June 30, 1996.	We agree with the recommendation.	Effect already given.
20.	The PRC/ERDAC and the outside experts consulted during the project selection and appraisal stage should be involved in mid-term evaluation of each ongoing project.	We agree with the recommendation.	It has been practised on selective basis.
21.	The role of DNES in the PACER program should be maintained during the rest of the program period.	We agree with the recommendation.	
22.	ERDAC should have more regular meetings, at least 4 times a year.	The frequency of ERDAC meetings depends on the flow of large projects for approval. PRC which has authority to approve projects meets more frequently.	
23.	The Secretariat should be strengthened by the addition of an electrical engineer. The secretariat should also add one administrative aide to assist with the RFP process and the unsolicited proposals.	We agree with the recommendation.	An electrical engineer with suitable industrial project consultancy experience in power plant as also ICICI operations has already joined PACER.



NEW DELHI, INDIA

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

July 1, 1991

MEMORANDUM

To See Distribution

From B R Patil, PDPS/PPE *BRP* 7/1/91

Subject Minutes of Mission Review Committee (MRC) Meeting
Program for the Acceleration of Commercial Energy Research
Project (PACER) - 386-0494

Please find attached herewith, for your information and record, the minutes of the Mission Review Committee (MRC) meeting of the Program for the Acceleration of Commercial Energy Research Project (PACER) project which was held on 5/20/91 in the Director's Conference Room

Encl a/s

Distribution:

D WGBollinger
DD STMintz
CO(A) NNWah
CO CMRaman
TDE(A) ABlumberg
TDE NVSeshadari
PDPS TMMahoney
PDPS ABSisson
PDPS BRPatil

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MINUTES OF MISSION REVIEW COMMITTEE (MRC) MEETING

PROGRAM FOR THE ACCELERATION OF COMMERCIAL ENERGY RESEARCH (386-0494)
MID-TERM EVALUATION

Date. 05/20/91
Time 1400-1600 Hrs
Venue Director's Conference Room

Purpose To approve the evaluation report and take follow-up action on significant recommendations

Attendees WBollinger - DIR
DPfeiffer - DD
TMahoney - PDPS (Chairperson)
RBeckman - TDE
NVSeshadri - TDE
JGrayzel - NRM
MCGupta - PDPS
BRPatil - PDPS
ETran - PDPS
CMRaman - CO
YPKumar - PDPS

Issues and Actions

Issue 1 Proposals solicitation through RFP process

Mission concurs with recommendation regarding the installation of the RFP process and will encourage an increasing percentage of subproject proposals to come through the RFP mechanism

Action None

Issue 2 Priority Setting

Contrary to the evaluation recommendation, Mission felt it necessary to encourage ERDAC to establish specific priority areas for PACER funding

Action TDE will discuss the issue with ICICI

Issue 3: Refocus of consortium concept

Mission accepts recommendation to continue with consortium concept with greater emphasis on combining manufacturers and end-users, but would like to explore the possibility of greater university involvement in the PACER program

Action TDE will discuss with the PACER Secretariat to look into means of including more university participants in PACER seminars and conferences and if possible, giving proposals with universities as participants additional points in the RFP process

Issue 4 Marketing and commercialization

Mission accepts recommendation to give more attention to marketing aspects both during the appraisal and the implementation stages

Action None

Issues 5&6: Grant repayment and long-term financial plan

It was pointed out that the project was not designed with the idea of creating a revolving fund for supporting further projects after the PACD but the project purpose was to establish/sustain the concept of consortium research in the country. In view of this, Mission felt that there was no need to increase the grant repayment limit of 200% as recommended by the evaluation.

With regard to a long term financial plan, Mission felt that it will not be feasible to work out such plan at this stage.

Action: TDE will take up the sustainability and related issues such as utilization of grant repayments with ICICI/ERDAC.

Issue 7 Outside specialized assistance

Mission endorses recommendation to include outside specialized assistance in subproject appraisal.

Action TDE will discuss the modalities with ICICI.

Issue 8 Administrative/organizational structure

Mission concurs with recommendation that major reorganization of administrative/operational structure is not required.

Action None

Issue 9• PACD Extension

Mission agrees with the recommendation to extend the PACD by three years from 6/30/93 to 6/30/96 to give additional processing time to new subprojects as well as to give time to complete the already approved projects

Action• TDE will confer with ICICI and following its Agreement to a three year extension submit an action memo to this effect

Issue 10 Approval of report

Mission approves the report and the recommendations contained therein except those related to priority setting (Recommendation # 1), limiting the amount of PACER contribution to \$2 million (Recommendation # 2), PACER funding to organizations that have other sources of funding (Recommendation # 4), Grant repayment and long term financial plans (Recommendation # 17 & 18) In respect of recommendation # 14 pertaining to PACER not funding any policy studies, Mission accepted the recommendation with the modification of funding such studies in exceptional cases

Clearance PDPS BRPatil (Draft)
PDPS ABSisson (Draft)
PDPS TMMahoney (Draft)
TDE RWBeckman (Draft)
CO CMRaman (Draft)
D WGBollinger WJB

Prepared
PDPS•BRPatil'ss 4276E 6/26/91



NEW DELHI INDIA

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

July 1, 1991

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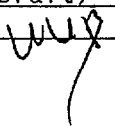
Issue 9 PACD Extension

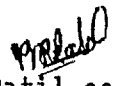
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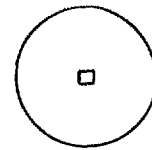

PDPS.BRPati1 ss 4276E 6/26/91

5 STATUS OF PROJECTS**Visited Projects****5.1 BHEL**

Project title	To develop Pressurised fluidised bed coal gasification with combined cycle power plant
Project Cost	Rs 131 million BHEL - Rs 65 million PACER - Rs 66 million
Proposed Schedule	R & D from July 1991 to June 1994 Commercialisation thereafter Work actually started only in 1993
Proposers	BHEL, Trichy (lead member) IIT, Madras Institute of Gas Technology (Pet - C), USA

Background

BHEL has been studying the possibility of coal gasification since 1980's. Power plants based on coal gasification using Integrated Gasification Combined Cycle (IGCC) are more efficient and environment friendly compared to conventional power plants based on pulverised coal. The process needs to be adapted to use Indian high ash coals. BHEL initially worked on a fixed bed gasifier project which was technologically proven but suffered from tar / phenolics problem and high capital and operating costs. Hence, it was decided to go in for a fluidised bed coal gasifier with a capacity to generate 6.6 MW of power.



Present Status

The plant is mechanically complete and erected in BHEL, Trichy in March 96. 10 operations have been completed so far. The gas turbine (GT) blades were found to be damaged during trials (damage could have been due to fixed bed gasifier, says BHEL). Mitsui (Japan) quoted an unaffordable Rs 100 million for repairs. Hence the gas turbine was shifted to BHEL, Hyderabad for repairs. BHEL feels that they have mastered the technology of repairing GT blades and saved foreign exchange in the process.

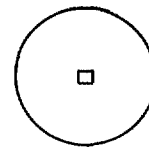
The GT is expected to arrive in Trichy around Sept - Oct 97. Independent trial operations of the GT are scheduled for Nov 97. 2 operations for the gasifier are also planned in Aug-Sept 97. After all these are complete, coupled operations will be taken up in January 98. The plant is expected to supply power to the grid from then on.

Once this is completed, BHEL intends to scale up the plant from 6.6 MW to 50 MW at Dadri (Haryana). This is subject to a tie up with NTPC. They have reportedly agreed to invest Rs 30 million / MW in the project and the balance is to come from BHEL. This too will be a 'demonstration' project.

Commercialisation of the technology is a long way off. The technology can be said to be commercialised only when the 50 MW plant can be operated, stabilised and its economics are proven. This would take at least 5-7 years.

BHEL apprehends competition from

- (i) Conventional pulverised coal technology - which is proven but inefficient
- (ii) Coal washing technologies - which could reduce ash content in coal and improve efficiency
- (iii) Other coal gasification technologies e.g. IGT



The concept needs to be sold aggressively This would probably require BHEL to promote BOLT projects using this technology

Repayments to PACER will commence only after commercialisation i.e. stabilisation of 50 MW plant

“Farfetched idea” is BHEL’s retort to the idea of repaying PACER since the gasifier technology is proven

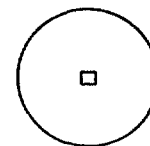
Savings & benefits

- To the country

Coal gasification can improve the efficiency by about 10 % The savings in coal will be therefore 10 % of the total coal consumption by Indian thermal power stations if the entire capacity were to shift to IGCC This is equivalent to 18.7 million T of coal (10 % of 187 million T) In rupee terms this is worth Rs 18,700 million This is however unlikely to be realised over the next 5 years due to the time taken to prove this technology in a 50 MW project

- From the project

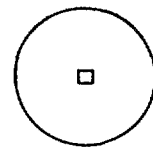
The 66 MW plant would have used 18000 T of coal every year A 10% saving would be translated into 1800 TPA of coal saved This is worth Rs 1.8 million pa Commercialisation and propagation of this technology will generate additional revenues

**5.2 Caldyn**

Project title	Cogeneration system for cement industry using waste heat recovery and agro waste
Project Cost	Rs 71 million Caldyn - Rs 18 million PACER - Rs 53 million
Proposed Schedule	Thermax and Dhar Cement had originally proposed pilot commercialisation of waste heat recovery system for cement industry and entered into an agreement in April 1994. Thermax withdrew from the consortium in October 94 and was replaced by Caldyn. Later, Dhar Cements withdrew from the consortium and was replaced by Shree Cement. The project was due to be commissioned by April 96.
Proposers	Caldyn Inc USA Caldyn Thermowir (P) Ltd Shree Cement Ltd

Background

Cement is an energy intensive industry. 60% of the energy is used for cement calcining process mainly for preheater and kiln, of which 40% is wasted and only 60% is utilised. Acute power shortages have led to production losses leading to lower profitability. Hence, the need to be energy efficient. It is proposed to install modules of "Multiwir" (a brand name of waste heat recovery system) to generate 1.3 MW of power at the 0.6 million TPA cement plant of Shree Cements in Beawar, Rajasthan. The Multiwir, which represents a combination of staggered packing and multicyclones shall remove heat from the flue gases. The exhaust gas from the cement kilns which have a high dust content is divided into 2 streams and the dust is collected over the walls. The dust can be removed with the help of a screw conveyor thus keeping the heat transfer tube free of dust.



Caldyn has already developed a 12 MW heat recovery system and successfully demonstrated the same in the aluminium industry. The Thermowir has been tried at the Dhar cement plant to generate steam with a high degree of success. However power generation with this steam has till now not been tested anywhere in the world.

Present Status

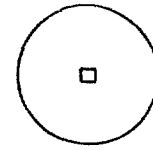
The initial modules of the Thermowir system have been already transported to Beawar. The remaining modules are being fabricated and are to undergo tests in Hyderabad before being despatched to Shree Cements Ltd. The plan for power generation through agrowaste has been shelved for the time being.

The project (revised) with Shree Cement was signed in March 97 and is expected to be completed in August 97. After the trial runs, Shree Cements would start making payments to Caldyn for the power generated @ Rs 2 / unit. Caldyn hopes to get enquiries from large cement companies after the plant trials at Beawar. Each Thermowir is expected to fetch Rs 4 million. The company has plans to buy a factory place at Hyderabad to produce 10 units per month.

Savings & benefits

- From the project

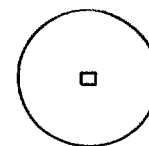
Caldyn expects to start commercial production by next year and repay PACER for its sales. Till then they will get paid by Shree Cements at the rate of Rs 2 per unit of power generated at the site. This will generate revenue of Rs 13 million p a. Otherwise Shree Cements would have to buy power from grid.



BUSINESS CONSULTING GROUP

- **To the country**

The country's cement production capacity is 73 million T and production is increasing every year. For this level of production (121 times Shree Cement's capacity) if all companies were to recover waste heat they would save Rs 1575 million p a



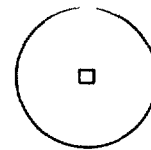
5.3 EcoSolar Systems India Pvt Ltd

Project title	Development and demonstration of a prototype line for manufacturing 700 kW of 300 x 300 mm CdS / Cd Te Solar cells using high-speed close-spaced sublimation and deposition under vacuum
Project Cost	Rs 31.7 million EcoSolar - Rs 8.2 million PACER - Rs 23.5 million including research grants
Proposed Schedule	Prototype development Sept 93 - Aug 95 Commercialisation after that
Proposers	EcoSolar, Pune Colorado State University, USA Pune University National Physical Laboratory

Background

EcoSolar's promoter Dr Nitant Mate studied in Pune University and Colorado State University (CSU). He has worked on technologies associated with thin film deposition of CdS / Cd Te under vacuum under guidance of CSU. In order to commercialise this, EcoSolar was formed and is working on attaining 'semi-commercial' status.

Developing this technology is the key to commercialisation of CdS / Cd Te based photo voltaic (PV) cells for power sector. Hence, the importance of this work.



Present Status

The technology has been developed and EcoSolar hopes to commercialise the technology on a very small scale in Aug-Sept 97. They could lose money in the first six months of operation.

EcoSolar will use systems integrators to introduce and popularise products based on technologies developed by them.

A new company "Nexus Energy Technologies" is to be promoted by Nitant Mate to develop commercial applications of solar energy. This could source PV cells from EcoSolar or from any other manufacturer.

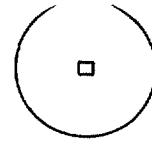
Repayment of conditional grants given by PACER could commence later this year and the repayment of whole amount will depend on market acceptance of these products.

EcoSolar & National Renewable Energy Laboratory (USA) feel that CdS / Cd Te based solar cells will pose strong competition to crystalline / amorphous Si based PV cells as well as CIS (Copper Indium Diselenide) based PV cells.

Savings & benefits

- To the country

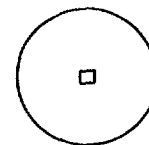
If 10 MW of power is generated through solar photovoltaic cells every year then savings in coal (Norm 0.63 T/ MWhr) would be 18396 T (10 MW*8 hrs*365 days*0.63 T) in the first year, 36972 T in year 2, and so on. In value terms, savings in next 5 years would be Rs 300 million. When annualised, the savings are Rs 60 million p a.



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- **From the Project**

The commercialisation of R & D done by EcoSolar will be done by another company. Hence, this particular project will generate returns only through sale of technology details of which are yet to be worked out



5 4 **Electrodynamics Industries**

Project title	Development of energy efficient high frequency portable tools		
Project Cost	Rs 9 million		
	Electrodynamics	-	Rs 2 25 million
	PACER	-	Rs 6 75 million
Proposed Schedule	Prototype Development	-	Aug 93 - Jul 95
	Commercialisation	-	After Jan 96
Proposers	Electrodynamics Industries IIT, Madras (IITM)		

Background

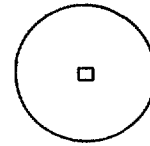
Tools such as grinders and drills are of 3 types

- pneumatic tools
- universal electric (UE) tools
- high frequency tools

The first two consume more energy but are established concepts HF tools are energy efficient, have a high power to weight ratio and are reportedly safer They are not made in India and imports are prohibitively expensive Service backup is absent for imported tools Electrodyn intends to develop 5 different tools (2 angle grinders, 1 die grinder and 2 drills) with built-in inverters

Present Status

Electrodyn has developed two of these tools (a drill & a grinder) which are undergoing tests The remaining 3 are also being developed in-house as the electronic circuitry for a built-in inverter could not be developed by IITM However, the development of drills is not being given priority because of the high competition expected from pneumatic tool manufacturers Since Jan 97, Electrodyn has been designing its own PCBs, tooling & material development



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The product to be launched first will be a grinder which has been already accepted when test marketed. Electrodyn intends to complete tests by September 97 and tie up with Electrex or L & T for marketing.

The plan is to make 1500-2000 grinders p a each costing Rs 20000 aggregating a turnover of Rs 30-40 million in the first year. These grinders will be very competitive with imported products (which cost £ 600-650 fob UK and whose landed price is Rs 36000-Rs 54000 at 0-25% duty protection).

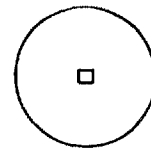
Since most parts will be sourced from subcontractors, the company will act as an assembler.

PACER grants will be repaid in a phased manner from 1997-98 onwards.

Savings & benefits

With the present rollout plans, Electrodyn hopes to sell Rs 300-400 million worth of HF tools in the next 5 years. Considering a payback period of 2.5 years, these tools are expected to lead to savings of Rs 600-700 million over the next five years.

On an annualised basis, the saving is Rs 120 million.



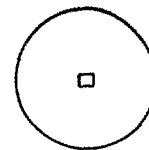
5.5 Essar Oil

Project title	Pilot project for exploiting adsorbed coal bed methane
Project Cost	Rs 105.4 million
	Essar Oil - Rs 50.5 million
	PACER - Rs 54.9 million
Proposed Schedule	Pilot project July 92 - Dec 93
	Commercialisation - April 93 onwards (from the first two wells)
Proposers	Essar Oil Ltd
	GMDC (Gujarat Mineral Development Corpn.)
	Coal India Ltd

Background

Coal mining becomes hazardous because methane adsorbed in the coal gets released during mining and could pose a fire hazard. Methane is a clean fuel and could replace natural gas. It could be piped directly to users or used to generate power.

Given the energy crisis in the country, it makes eminent sense to exploit the coal bed methane resource. Coal Bed Methane (CBM) recovery has been successfully established in certain parts of USA. The exploration and production process however need to be tailored to the conditions prevailing in India. The project of Essar was a first step in understanding the gas volumes, pressures and operating parameters needed to successfully exploit the reserves available in the country. The project initially envisaged drilling 2 wells each in Mehsana, Gujarat and Jharia, Bihar. However, due to certain difficulties in working with Coal India in Bihar, this location was dropped and one more well was included at Mehsana location. Based on the data collection, a commercial venture of 100 wells with an investment of about Rs 1,700 million was envisaged.



Present Status

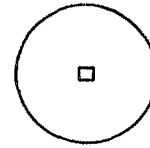
Of the three wells dug, 2 are not operational at present and 1 well is producing methane gas. Adequate data has been collected to establish the volumes and pressures. But in order to establish commercial viability some more work is involved. It is not clear as to why this was not envisaged earlier. A couple of 5 spots (involving around 10-12 wells) need to be done to establish commercial feasibility. This would need significant investment and may take anywhere from 6 months to 2 years. In the meanwhile, given uncertainty about ownership issue between the Central and State Governments, Essar has slowed down work on Phase II.

Repayments to PACER would take time- at least 2 years till phase II results are available.

Savings & benefits

- To the country

The total production per well was envisaged earlier at 25000 cum / day & 350 operating days per year. This at a gas price of Rs 1800/ cum was yielding a realisation of Rs 15.7 million. It was equivalent to saving 8125 T of oil per year. The original plan envisaged production of 2 million cum / day equivalent to 0.65 million T / year of crude oil, this translates at gas price of Rs 1800 per cum to Rs 1260 million / year. As per current indications, this level of production can be achieved and may be even exceeded, though number of wells required may be more than that envisaged earlier. The total production potential of CBM from Jharia, Raniganj and Mehsana is about 15 million cum / day which translates to Rs 10000 million per year.

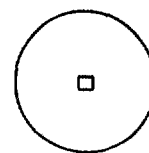


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The project has had the desired impact in the national context. The Central Government has already realised the potential and has come with a national policy for exploitation of CBM and has invited global bids for the same.

- **From the project**

The work done to date has generated data which is considered adequate to establish volumes and pressures. Significant investment is required before the project can start generating revenues.



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5 6 KTIL

Project title	Development of Advanced PINCH technology software
Project Cost	Rs 66 5 million
	KTIL - Rs 7 2 million
	Linhoff March Inc - USD 445,470 (Rs 16 million)
	PACER - Rs 43 2 million
Schedule	April 1993 to April 1995
	Commercialisation thereafter

Background

Linhoff March Inc (LMI) has developed software for application of PINCH technology LMI in conjunction with KTIL proposes to upgrade the existing software for application of PINCH technology to the Indian process industry

It was proposed to demonstrate the use of PINCH technology alongwith the upgradation of software Three pilot projects would be conducted in representative industries

Repayments to PACER were envisaged from

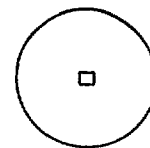
- energy savings in Pilot projects
- Sale of services in India of advanced PINCH technology software

Present Status

The three pilot projects envisaged during the proposal stage could not be taken up due to lack of interest from the endusers

Two pilot projects were taken up with Ganesh Anhydride and Clarissis Organics These have been completed as of July 1997 The savings envisaged have been achieved and with minimal investments in plant modification

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A third project was taken up on a commercial basis with Indian Oil Corporation (IOC) and is expected to be completed by December 1997. The work could not be taken up as a pilot project because of the reluctance of IOC to team up with a private sector company for research. This project has been taken up under the heading of "increase in throughput" rather than an energy savings project which in a way reflects the hurdles in commercialisation of this technology.

KTIL expects to start repayments to ICICI in 1998 after it bags some orders for application of this technology based on the successful demonstration of the pilot projects.

Savings & Benefits

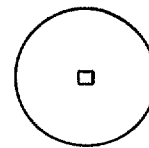
- To the country

Though the advantages of PINCH technology are known across the process industry, commercialisation of this technology on a large scale in the near future is doubtful.

This is primarily because the Indian industry in general, is more pre-occupied with investments in capacity enhancement than energy savings. This is because the former reflects in turnover growth which is highly visible rather than the latter which reflects only in reduction of energy cost.

The high energy consuming sectors like petroleum and petrochemicals are still dominated by the Government where the focus on capacity enhancement is even higher.

Hence, a realistic scenario of commercialisation would be about 8 - 10 projects across various industries over the next 5 years.

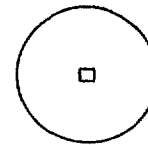


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However, as per KTIL, the saving in fuel bill due to PINCH technology, could correspond to about USD 110 million per year considering a saving percentage as low as 1.5% in the 12 refineries of the country. At current exchange rates, the savings aggregate Rs 4000 million p.a.

- From the Project

There are no direct energy savings from the project. KTIL would have to commercialise and propagate PINCH technology to repay PACER grants.

**5 7 SECO Controls Pvt Ltd**

Project title	Development & demonstration of low cost combustion control system based on oxygen sensing		
Project Cost	Rs 0 8 million		
	Nagadi (SECO)	-	Rs 0 35 million
	Micro Controls	-	Rs 0 05 million
	PACER	-	Rs 0 40 million
Proposed Schedule	R & D Aug 89	-	Feb 90
	Commercialisation	-	March 90 onwards
Proposers	Nagadi (SECO)		
	Micro Controls		
	IIT, Madras		

Background

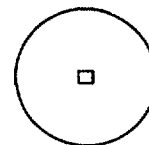
SECO '(Saving Energy through Controls)' had its origin in Nagadi Consultants - a company founded by Mr T Jayaraman with the objective of promoting energy management & conservation with a special emphasis on combustion control. SECO's product uses a low-cost adaptive control logic to provide close control of parameters and optimise fuel usage.

Present Status

The company has commercialised its operations since 1990-91 and is slowly expanding the business volumes. Most of SECO's business comes from sales of oxygen sensors to petrochemical, refineries & steel plants. Turnover fluctuates from year to year with orders booked. The lack of 'energy consciousness' among users is blamed by SECO as the reason for low growth. However, the company's poor marketing set up is likely to be the major problem. By 1997-98, SECO hopes to repay the original amount of Rs 0 4 million taken from PACER. The balance will be paid over the next 2-3 years.

Savings & benefits

Considering the low-key marketing efforts, the potential savings from this project are reckoned at around Rs 4 million p a considering 2 years payback.



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5 8 SPIC Science Foundation

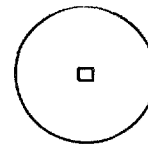
Project title	Development & demonstration of solid polymer electrolyte fuel cells (SPEFC) stacks in the range of 1 to 5 KW		
Project Cost	Rs 25 million		
	SPIC Science Foundation	-	Rs 12 5 million
	PACER	-	Rs 12 5 million
Proposed Schedule	R & D Oct 89 - Sept 92		
	Commercialisation - April 94 onwards		
Proposers	SPIC Science Foundation (SSF), Madras		
	SPIC		
	Texas A & M University		

Background

SPIC has a caustic - chlorine complex in Madras where hydrogen is available. The surplus hydrogen which could be a source of energy is flared. A consortium consisting of SPIC and SSF intends to develop SPEFC stacks which could convert hydrogen into useful energy. The Chloralkali industry is an energy - intensive industry and savings on energy can directly contribute to the bottomline.

A fuel cell generates electricity at 40% efficiency and with proper heat recovery systems, the overall efficiency of the plant could be 70-80% as against 30-35% efficiency in conventional thermal plants.

SSF had originally proposed to import a prototype (3 KW size) and go in for reverse engineering. This however did not work out and SSF had to develop it from a scratch.



Present Status

The SPEFC stack development process for 1-5 KW range is complete. But this is not useable in the electrolysis cell in chloralkali industry. The electrolysis cell needs high amperage and low voltage power. SSF will have to spend money on power technology required to do so. This is a bottleneck.

SSF has tried to scale up the fuel cell upto 50 KW in one module. This had failed. Hence, SSF is working on developing the fuel cell in steps in a long drawn out programme. This has backing from MNES funds (Rs 18 million over 2 years).

DuPont had expressed interest in scaling up the SPEFC to 500 MW at a cost of Rs 570 million but have not followed up after Dr Parthasarathy's (ex-head of SSF) death. DuPont is currently preoccupied with own restructuring, according to SSF.

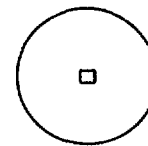
Considering that the entire process calls for huge investments, SSF is evaluating sale of technology / joint R & D with DuPont, Petronas (Malaysia), etc. This would however have to be so structured that PACER and MNES grants are repaid. This seems difficult.

SSF is also evaluating the prospects for component-wise technology transfer so as to generate resources for the programme.

Repayments to PACER can take place only if it succeeds.

Savings & benefits

The savings and benefits cannot be quantified for now since the project is unlikely to be commercialised in the next 5 years. On an annualised basis, the energy saving is Rs 6 million p a.



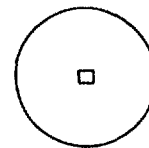
5 9 Solker Enterprises P Ltd

Project title	Market seeding for accelerating commercialisation of an innovative Solar Meal Maker (SMM)		
Project Cost	Rs 6 2 million		
	SEPL	-	Rs 1 6 million
	PACER	-	Rs 4 6 million
Proposed Schedule	July 93 - June 94		
Proposers	Solker Enterprises Pvt Ltd , Madras Anna University		

Background

SEPL was promoted by Solker - a manufacturer of PV based system and Dr K Schwarzer of Germany Dr Schwarzer invented the SMM which is better than the box type solar cookers available in India SMM is suitable for cooking large amounts of food and one-time capital expenditure can save fuel (recurring expenditure) in orphanages, community kitchens, etc

In the SMM, groundnut oil is heated to a temperature of about 180°C by circulating it through a copper pipe exposed to the sun This hot oil then circulates through 2 jacketed SS vessels The cooking is done on the vessel itself It offers facilities such as cooking from inside the kitchen and night storage facility by storing the heated oil in a pebble storage container Solker wanted to test out the product, recipes and response of initial buyers to the product with the assistance of Anna University This would help in market seeding and accelerated commercialisation



Present Status

Solker is busy marketing PV modules, hot water systems and drying systems in and around Madras. They have not been able to make a break through in meal makers because of the unethical business practices followed by the previous Tamil Nadu Government. However, Solker is optimistic that in a couple of years TN Government will become a buyer for SMMs. They have already made provisions in the present State budget.

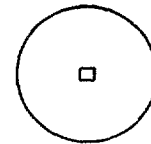
Only 24 SMMs have been manufactured by Solker of which 15 have been sold to NGOs and the rest are being used for demonstration at various sites. Anna University played a role in designing, manufacturing process of SMMs, working out recipes etc. but could not proceed with field data analysis as there were very few SMMs in the field.

It is only after establishing itself in Tamil Nadu that Solker wants to venture out into other states. At a capital cost of Rs 32,500 per SMM, the 45,000 noon meal centers in TN itself represent an opportunity of Rs 1,460 million. These SMMs have a payback of 2 years at present kerosene prices. This will improve further when the subsidy on SKO is reduced and SKO prices go up.

PACER will have to wait for another year or two before SMMs are sold to TN Government and the remaining grants are repaid.

Savings & benefits

Solker expects that the country will benefit to the extent of Rs 30 million as fuel savings by using 500 solar mealmakers over the next 5 years.



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5 10 ST - BSES Limited

Project title	Plant for beneficiation of Indian high ash coals by coal washing		
Project Cost	Rs 132 7 million		
	Proposers	-	Rs 33 2 million
	PACER	-	Rs 99 5 million
Proposed Schedule	Apr 97 - June 98		
Proposers	BSES Ltd)	ST - BSES Ltd
	Spectrum Technologies)	
	CLI, USA		

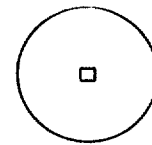
Background

Indian coals have high ash content (45%) which should be washed to around 30% and lower so that money is not wasted in transportation of ash and pollution of environment. While all agree with the principle, there was no unanimity about who would spend for this - the coal miner or the utility company. ST-BSES has belled the cat and gone into the business with a 500 TPH coal washery. For BSES plant at Dahanu, near Bombay the coal linkage is in far away Madhya Pradesh which makes transport cost higher than cost of coal itself. Hence, it is necessary to improve quality of Indian coals.

ST- BSES intends to show that Indian coals too can be washed in a cost effective manner.

Present Status

Foundation work at Korba (MP) is complete and fabrication has started. Imported equipment has landed (e.g. Banana screen) in Bombay port. The plant trials are expected around June 1998.



Repayments to PACER are linked to the quantity of coal processed at Korba or any other site of ST - BSES JV and will hence begin in June 98

Savings & benefits

- To the country

The total coal consumption in the country is around 250 million T. The amount of coal transported beyond 750 km is about 100 million T. At the rate of Rs 700 per T, this amounts to Rs 70,000 million. If coal is beneficiated then transport savings could be 16 % i.e. Rs 11,550 million.

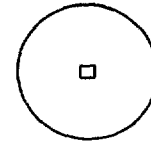
Savings would also be in the form of better boiler efficiency, gross heat rate, maintenance etc. with the usage of beneficiated coal. All this will give a savings of Rs 500 million for the Dahanu plant using 2 million T of coal p.a. Hence the overall savings in the country due to better efficiency would be around Rs 25,000 million (Rs 500 mn * 100 million T / 2 million T).

The total savings on transport and plant efficiency improvement will be even higher at around Rs 36,550 million, if all were to shift to beneficiated coal in the next few years.

- From the Project

The Dahanu plant of BSES will save Rs 500 million on account of better plant performance. Also savings in transportation cost will be (2 million T x 700 x 0.16) Rs 224 million p.a.

Hence, the benefits from the project total Rs 724 million p.a.



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5 11 Suryodaya

Project title Development and demonstration of technology for solar thermal generation plant by developing a parabolic trough collector

Project Cost Rs 18 million
Suryodaya - Rs 9 million
PACER - Rs 9 million

Proposed Schedule April 94 - Oct 95 (18 months)

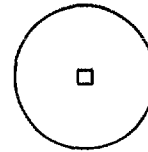
Proposers Suryodaya Iitech Engg (P) Ltd (SHEL)
RES Photovoltaic Ltd (RESPV)
RES Energy System Ltd (RES)
NAL
ITC Bhadrachalam Paper Boards Ltd (ITCB)

Background

The Renewable Energy Systems (RES) Group was founded by a team of first generation technocrats, entrepreneurs and professionals to manufacture customised solar photovoltaic systems, thermal batteries, photovoltaic cells and modules, etc RES acquired SIHEL to manufacture, solar thermal system including collectors, drying systems, hot water systems, etc RES therefore planned to manufacture steam generation system as a logical extension of their product If successful, this development could substitute conventional fuels with solar energy

Present Status

The first phase would involve generating 100 kg / hr of steam at the ITCB plant for about 5 hours of a total requirement of 1 T / hr This is likely to be completed by August 30, 97 and will need about 12 units of collector each of roughly 12 m² area The parabolic collector troughs (PTCs) being manufactured currently are 35-40% costlier than flat collector on K Cal / m²



basis The proposers will prove the technology only The commercial viability can be tested only after the technology is proved It is critical that sale of parabolic trough collectors is subsidised or an innovative financing method is used The commercial scale production of PTCs would have to be taken up as another independent project needing more time and funds which have not been quantified Hence payback to ICICI seems difficult at this stage of project The proposers - RES Group and ITCB have been showing poor financial results and hence had to put this project on back-burner This slowed the progress in implementation of the steam generating system The integration of all systems to generate 1 T / hr steam will take a few more months after the 1st phase of 100 kg / hr is successful

Savings & benefits

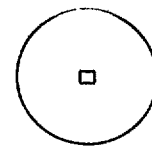
- To the country

A 400 kg / hr plant running for 5 hrs for 270 days would save 44,250 litres of fuel equivalent to Rs 265,500 per year (Price of fuel Rs 6 / litre)

If every year systems of 20 T / hr steam generation are installed, then the savings in the 1st year will be $(20 / 0.4 \times 2.65 \text{ lacs} = 13.25 \text{ mn})$ Rs 13 million, Rs 25 million in year 2 and so on totalling upto about Rs 200 million in the next 5 years On an annualised basis, this equals Rs 40 million per year

- From the project

The total steam generation will be about 1 T / hr saving upto 1.1 lac litres of fuel equivalent to Rs 0.66 million per year

**5 12 VSI / Krishna SSK**

Project title	Demonstration of technology for treatment of distillery spent wash along with cogeneration of steam and power
Project Cost	Rs 70 million
	IDBI - Rs 15 million
	Krishna - Rs 21.8 million
	VSI - Rs 3.2 million
	PACER - Rs 30 million
Proposed Schedule	Development project - April 92 to September 93
	Commercialisation project - Oct 93 onwards
Proposers	Krishna SSK, Karad (Maharashtra)
	Vasantdada Sugar Institute, Pune

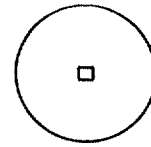
Background

Spent wash produced by distilleries presents a disposal problem today. It pollutes the soil and leaches into water bodies around the distilleries if left untreated. Bio-methanation techniques help reduce pollution and also generate methane.

The VSI system called Drying, Incineration and Energy Generation (DIEG) could become a 'Zero pollution' method of disposal of spent wash. This could also generate steam, power and ash containing K_2O .

Present Status

The mechanical erection of the plant for one module of distillery (30 KLPD) is complete. The DIEG method produces a sawdust-like spent wash powder which needs to be incinerated to generate steam and power. However, it is hygroscopic and cannot be stored for long. It also chars at high temperatures. Hence, proper control of pressure, temperature and velocity is required. This control is currently being developed at VSI.



Krishna SSK is anxious to complete the project quickly as two modules of distillery are presently shut for pollution reasons. The pollution and electricity problems will also be resolved to a large extent. The loss of profits on account of distillery closure will also be stopped.

VSI expects that trials will be initiated in Sept 97 and completed by Dec 97.

In January '98, Krishna SSK intends to place orders for DIEG for the remaining 45 KLPD capacity also. This is subject to successful commissioning of the first DIEG plant then.

Krishna is apprehensive about the high capital cost of DIEG (Rs 70 million vs Rs 20-30 million for biomethanation route) but feels that MPCB will encourage zero pollution concept of this process. Operating costs are an issue and need to be worked out during the trial period.

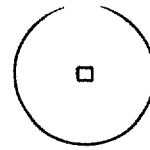
Most of the PACER grants will have to be repaid by VSI through sale of technology to other distilleries. Krishna SSK will only repay a limited amount raised by sale of surplus steam and electricity.

Savings & benefits

- From the project

The demonstration plant for a 30000 litres/day capacity can give 90 TPD of steam and 200 kW of power at the rate of Rs 300/ T of steam and Rs 3.1 per KWH, the total savings will be Rs 10.4 million per year (including about Rs 0.3 million from potash sales @ Rs 200/ T).

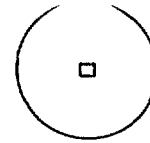
It has been assumed that the distillery will run for 8 months in a year.



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- **To the country**

The total saving for 1500 million litre p a alcohol capacity in the country will hence be Rs 1730 million p a This excludes benefits derived from reduction in pollution



5 13 Other Projects

The following sections contain a summary of the present status of those projects financed under PACER which have not been met during the field study Inputs for this section have been received from PACER secretariat

5 14 Aditya Solar

Project title Development & demonstration of technology for solar
thermal process steam generation plant

Project cost Rs 3 34 million

 PACER contribution - Rs 2 50 million

 Proposers contribution - Rs 0 84 million

Proposed completion date June 1997

Proposers AJ Electronics, Pune

 School of Energy, Pune University

 Surya Technical Consultancy P Ltd

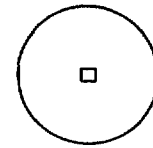
 Shivamrut Doodh Utpadak Sangh

Background

A RFP was floated for a 100 kg / hour solar thermal process steam generation plant The 'Aditya Solar' consortium was formed for executing this project The user of the technology is Shivamrut Dairy

Present Status

The consortium has finalised the system configuration The sub components of the system have been designed & their manufacturing processes have been finalised The first prototype has been built & its performance is satisfactory Procurement for the 100 kg / hr system has begun Some equipments have been shifted to site Site preparation has been carried out at the user's site The project cost has increased marginally to Rs 3 34 million PRC has



approved additional assistance of Rs 0.25 million to meet cost overrun. The project is likely to be commissioned shortly.

5.15 Ahmedabad Textile Industry Research Association (ATIRA)

Project title Development of lignite water fuel technology

Project cost Rs 278 million

 PACER contribution - Rs 71 million

 Proposers contribution - Rs 207 million

Proposers ATIRA, Ahmedabad

 UNDSEM (University of North Dakota - School of Engg
& Mines)

Present Status

The project has since been cancelled. The consortium failed to take off. While UNDSEM has refunded the whole amount disbursed, ATIRA has appealed for a write-off. Auditors have been appointed to evaluate allowable expenses.

5.16 Ankur Energy & Development (Ankur / Ascent)

Project title Development of 500 kW biomass gasifier based power
 generation system

Project cost Rs 2 million

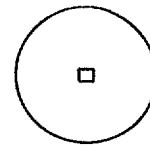
 PACER contribution - Rs 1 million

 Proposers contribution - Rs 1 million

Proposed completion date October 1992

Proposers Ankur Energy & Devp Alternative, Baroda

 Ankur Scientific Energy Technologies P Ltd



BUSINESS CONSULTING GROUP

Background

The potential for renewable energy as a source of grid power can be realised only if an impetus is given to R&D work in this area. The development of a 500 kW_e biomass gasifier based power generation system is a step in this regard.

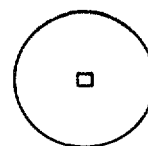
Present Status

The project has been completed at Rs 2 million as against the originally estimated cost of Rs 3.05 million. Correspondingly, the PACER assistance for the project has also been reduced to Rs 1 million. PACER has provided further support to the market development programme of Ankur / Ascent.

MNES has decided to extend subsidy to the 500 kW_e biomass gasification system. Ankur has recently received orders from Gujarat (GEDA) & Madhya Pradesh. The company has started paying the reflow to PACER.

5.17 Dhar Cement Ltd

Project title	Development & demonstration of waste heat recovery based captive power plant for cement industry
Project cost	Rs 28.4 million
	PACER contribution - Rs 19.4 million
	Proposers contribution - Rs 9.0 million
Proposers	Dhar Cement Ltd Caldyn Consultants (I) Pvt. Ltd



Present Status

Due to the inability of the main proposer i.e. DCL to bring in the proposer's contribution in time, the assistance to DCL was cancelled. The project is now being implemented in Shree Cement Ltd, which is likely to be commissioned by December 1997.

5.18 Elpro International Ltd

Project title Development of biomass fired Stirling engine based water pump

Project Cost Rs. 12 million

PACER contribution - Rs. 8.5 million

Proposers contribution - Rs. 3.5 million

Proposed completion date August 1997

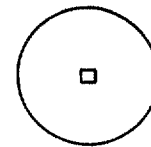
Proposers Elpro International Ltd
Sunpower, Inc

Background

Water pumps based on renewable energy sources could help provide precious water in areas not connected by pipeline. This will reduce the dependence on electricity whose supply is erratic as well as the dependence on diesel (petroleum product).

Present Status

The consortium changed the concept due to drawbacks in the earlier design. The prototype engine / pump based on the revised design has been constructed. After achieving the desired level of performance, it is likely to be shifted to Elpro along with the burner. Meanwhile, based on the revised



BUSINESS CONSULTING GROUP

design the procurement of components & tooling for manufacturing 25 pieces has commenced. The project is expected to be completed by November 1997.

5.19 Fluidtherm Technology P Ltd

Project title Development of continuous fluidised bed furnace for heat treatment

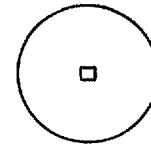
Project cost Rs 8.2 million
PACER contribution - Rs 3.46 million
Proposers contribution - Rs 4.74 million

Proposed completion date March 1995

Proposers Fluidtherm Technology P Ltd, Madras
TI Diamond Chain Ltd
IIT, Madras

Present Status

The company has completed development of one type of furnace. In the absence of a sufficient market for the balance 3 furnaces, Fluidtherm has indicated that it would not like to proceed further. Thus the PACER assistance to the project is reduced to Rs 3.46 million. Fluidtherm has commercialised the product and reflows have commenced.



BUSINESS CONSULTING GROUP

5 20 Grain Processing Industries (I) Ltd

Project title Upgradation of technology for 500 KVA power generation
 system based on gasification of rice husk

Project cost Rs 4 2 million

 PACER contribution - Rs 2 1 million

 Proposers contribution - Rs 2 1 million

Proposed completion date June 1996

Proposers GPIL

 IIT, Kharagpur

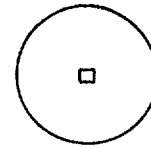
 Bijoy Lakshmi Rice Mill

Background

Rice husk is a waste product of rice mills. Its disposal generally creates problems. The husk can be gasified & used to generate power. The technology upgradation of this concept was financed under PACER.

Present Status

GPIL has completed the project. It has received an order from Guyana (South America) & 2 from India. A request for assistance in developing a bagasse gasifier is pending with the PACER secretariat. PACER Secretariat may consider the financing the same through reflows. Meanwhile the company has commercialised the product and started making the repayment to PACER.



5 21 Lotus

Project title Cogeneration plant based on phased out aero engines
Project cost Rs 1 2 million
PACER contribution - Rs 0 6 million
Proposers contribution - Rs 0 6 million
Proposers Lotus Energy Systems Pvt Ltd
National Aeronautical Laboratory

Present status

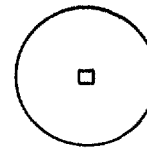
The project was to develop co-generation plant (1000 KVA and 600 kg/hr steam) based on phased out aero engine with automated control system. The project was implemented partly. However, due to non-availability of suitable aero engines and differences between consortium members (NAL & Lotus), the project could not proceed further.

5 22 MECON

Project title 15 kW desiccant cooling system based on industrial waste heat
Project cost Rs 0 4 million
PACER contribution - Rs 0 2 million
Proposers contribution - Rs 0 2 million

Project status

The first phase of the project was completed wherein 9 15 KW prototype of desiccant cooling system was developed. However, while scaling up the design to 15 KW, MECON came to the conclusion that the size and cost of



this system will not make it techno-commercially viable. It was therefore decided to abandon further implementation of the project.

5.23 Oil India Limited

Project title Pilot plant for co-processing of Assam Coal & Oil
(vacuum residues) into clean liquid fuels

Project Cost Rs 89.50 million

PACER contribution - Rs 51.75 million

Proposers contribution - Rs 37.75 million

Proposed completion date June 1997

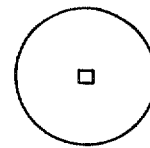
Proposers Oil India Limited
HRI, Inc

Background

The country is importing liquid fuels while it is unable to convert available resources in Assam (coal & vacuum residues of oil) into useful fuels. Co-processing of Assam coal & oil into clean liquid fuels will have to be proved in a pilot plant. This, when proven, will form the basis for commercialising the technology.

Present Status

The erection of the pilot plant has been delayed. The main reasons were delay in awarding contracts for civil, electrical & mechanical erection work, procedural delays and delays in supply of instruments, pipeline & controls as well as the prevailing law & order situation in Assam. During the pre-commissioning trials / testing the pneumatic piping of the instrumentation system failed at just one-fifth the design pressure. Therefore, there has been a further delay in commissioning the pilot plant. The plant is now expected to be commissioned at an early date.



5 24 Plumac Power Systems Pvt Ltd (now, HBL Limited)

Project title Development & demonstration of deep discharge lead acid
batteries

Project cost Rs 5 3 million
PACER contribution - Rs 2 0 million
Proposers contribution - Rs 3 3 million

Proposers Plumac Power Systems P Ltd , Hyderabad
Hyderabad Batteries Ltd

Present Status

The development activity has concluded. The company has forwarded batteries of various ratings to DOT and Indian Railways. Trial orders have been received from Railways. Commercialisation has commenced with effect from December 1995. The company has also set up manufacturing franchisees at its own expense. PACER has received the reflows.

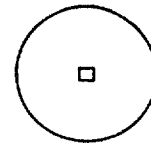
5 25 Saveoil

Project title Development of emulsifier

Project cost Rs 2 3 million
PACER contribution - Rs 1 5 million
Proposers contribution - Rs 0 8 million

Present status

Saveoil tried to develop the emulsifier through NCL. The product could not match the long term requirement (shelf life of 6 months). The company therefore adopted the technology transfer route and agreed to repay the full amount taken from PACER. Reflows to PACER have commenced.



BUSINESS CONSULTING GROUP

5 26 S&S Power Switchgear Ltd

Project title Development of vacuum auto recloser with magnetic
 actuator for tail-end distribution system

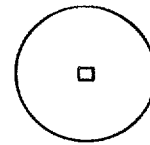
Project cost Rs 5 2 million
 PACER contribution - Rs 2 6 million
 Proposers contribution - Rs 2 6 million

Proposed completion date March 1995

Proposers S&S Power Switchgear Ltd , Madras
 IIT, Madras

Present Status

The company has commenced commercial sales of products developed under
PACER Sales already exceed Rs 1 8 million Reflows have commenced



BUSINESS CONSULTING GROUP

5 27 Thermax Ltd

Project title Development of a regenerative burner for energy
conservation in a foundry

Project cost Rs 1 60 million
PACER contribution - Rs 0 8 million
Proposers contribution - Rs 0 8 million

Proposed completion date July 1992

Proposers Thermax Ltd , Pune
Trinity Forge Ltd , Pune

Background

Iron and steel foundries need to be vigilant about energy conservation because energy forms a chunk of their conversion costs. It was hence felt that developing and demonstrating the use of an energy efficient regenerative burner would be of use to the industry.

Present Status

The project has been completed. Thermax has agreed to repay Rs 0 75 million to PACER. The matter is being pursued.

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SUMMARY STATEMENT OF HOST COUNTRY CONTRIBUTION
As on August 31, 1997

Project No. 386 0494

Project Title Program for Acceleration of Commercial Energy Research
(PACER)

Project Element/ Activity		US\$ '000			Rs. '000		
		AID	Estimated Subproject	Budget Total	Cummulative In Kind	Host Country Cash	Contribution Total
A	PACER Projects						
1	Market driven tech dev consortia	17,250	11,875	29,125	16,511	477,271	493,782
2	Competitive awards program	500	125	625	-	-	-
3	Supporting analysis and outreach	1,000	-	1,000	-	-	-
4	U S short term tech assistance	500	-	500	-	-	-
5	Project administration including secretariat	600	-	600	21,095	-	21,095
6	Project evaluation/ audit	150	-	150	-	-	-
	Sub-total (A)	20,000	12,000	32,000	37,606	477,271	514,877

Signature
Name of Authorised Rep
Designation


N G Pai
Deputy General Manager

SUMMARY STATEMENT OF HOST COUNTRY CONTRIBUTION
As on August 31, 1997

(Rs in '000)

Comp 1 Subproject Title		Estimated Budget			Cumulative Host Country Contribution		
		AID	Subproject	Total	In Kind	Cash	Total
A	PACER Projects						
1	SPIC	12,000	13,100	25,100	7,732	13,069	20,801
2	Fluidtherm	4,100	4,100	8,200	0	4,642	4,642
3	MECON	550	550	1,100	1,569	220	1,789
4	Lotus	700	700	1,400	0	130	130
5	Plumac	2,000	3,300	5,300	0	3,857	3,857
6	BHEL	64,980	65,000	129,980	4,080	62,432	66,512
7	S&S	2,600	2,600	5,200	400	2,854	3,254
8	OIL	45,517	37,500	83,017	400	79,600	80,000
9	ESSAR	50,000	56,500	106,500	0	127,687	127,687
10	VSI	30,000	40,000	70,000	200	46,021	46,221
11	Save Oil	1,500	800	2,300	0	700	700
12	KTI	13,400	7,200	20,600	0	8,173	8,173
13	Ecosolar [*]	23,379	8,200	31,579	280	9,787	10,067
14	Electrodynamics	6,750	2,250	9,000	0	2,381	2,381
15	Solker	1,936	646	2,582	0	646	646
16	GPIL	2,100	2,100	4,200	0	2,430	2,430
17	Dhar	75,000	35,000	110,000	0	4,700	4,700
18	SECO	400	400	800	0	378	378
19	Thermax	800	800	1,600	0	750	750
20	Ankur	1,000	1,000	2,000	0	1,000	1,000
21	Ankur (Mkt)	650	400	1,050	0	543	543
22	SECO (Mkt)	1,200	500	1,700	50	1,617	1,667
23	Elpro	8,500	3,500	12,000	0	7,989	7,989
24	Suryodaya	9,000	9,000	18,000	0	5,500	5,500
25	Aditya/A J electro-nics	2,250	750	3,000	0	835	835
26	Caldyn/Shree	53,200	17,800	71,000	0	17,800	17,800
27	ST-BSES	99,600	33,200	132,800	0	63,330	63,330
28	CLI	24,300	8,100	32,400	1,800	8,200	10,000
Sub-total (A)		537,412	354,996	892,408	16,511	477,271	493,782

* The Combined Cycle Demonstration Plant (CCDP) built by BHEL in 1986 at a cost of Rs 150,000,000 is the basis for the project. The WDV as of March 31, 1992 would work

EXPENSES OF ICICI ON PACER

(Rs in lacs)

Year ended on March 31,	Salaries	Overheads Office, Perks Establishments	Total
1988	2 62	15 00	17 62
1989	3 36	16 40	19 76
1990	5 30	18 08	23 38
1991	5 39	20 10	25 49
1992	8 45	20 10	28 55
1993	9 96	14 00	23 96
1994	11 77	11 00	22 77
1995	15 38	12 00	27 38
1996	14 87	18 00	32 87
1997	12 57	15 00	27 57
1998 *	5 30	6 30	11 60
			260 95
Less claimed amount from USAID			50 00
			210 95

* (for 5 month period ending August 31, 1997)

**Completion Status and Commercialization plans of PACER sub-projects
under implementation/completed but not commercialized**

	<u>Subprojects</u>	<u>Status</u>	<u>Plans</u>
1	Suryodaya Hi-tech	Erection of demo plant at ITC Bhadrachalam delayed due to financial constraints faced by ITC	Suryodaya searching for alternate buyers of technology
2	Elpro Int'l	First prototype system not achieving desired performance level due to technological issues	Elpro Int'l in process of resolving technological issues
3	Oil India	Info awaited	Info awaited
4	ST/BSES Coal Washery	PACER portion of the project completed Commissioning is dependent upon completion of the other linked project	Commissioning of the complete project is expected by October 1998
5	CLI Coal Handling ST/BSES	Same as in no 4 above	- do -
6	Spic Science Foundation	Completed	SPIC Ltd has no immediate plans for commercialization due to unfavorable economic viability
7	BHEL/IIT, Chennai	Completed	Market mainly for high rating IGCC power plants Efforts are underway to explore possibility of commercialization
8	Vasantdada Sugar Institute	Completed	Testing period extended Commercialization will be done later
9	Essar Oil Ltd	Completed	Technology successfully demonstrated Commercialization contingent upon securing GOI contract through formal bidding process